VDH VIRGINIA DEPARTMENT OF HEALTH
Protecting You and Your Environment

Virginia Department of Health

DIVISION OF HEALTH HAZARDS CONTROL

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BIOAEROSOLS

GENERAL

Bioaerosols include microbial cells (microorganisms), their reproductive units, and associated metabolites that are volatile or small enough to sufficiently achieve aerial dispersion. Categories of bioaerosols include viruses, bacteria, fungi, algae, and protozoa and their products (Burge, 1990a). These microorganisms and their byproducts are naturally occurring and are considered to be ubiquitous. Under certain environmental conditions, many bioaerosols can cause varying symptoms, disorders, and diseases in humans, and they can survive for extended periods.

Microorganisms are a normal and essential component of the earth's terrestrial and aquatic ecosystems. Bacteria and fungi break down the complex molecules found in dead organic materials from animals and plants, and recycle minerals and carbon to simple substances such as carbon dioxide and nitrates. Microorganisms such as saprophytic bacteria and fungi, which derive nutrients from non-living materials in the environment, are commonly found in the soil and the atmosphere (Morey and Feeley, 1990).

Many of the medical symptoms of bioaerosol exposure are accentuated in indoor environments due to the accumulation of the specific bioaerosol(s) as the result of poor building ventilation. Microbial contamination in buildings can usually be tracked back to either unsanitary mechanical equipment (e.g., growth in condensate pans, dirty filters and/or ductwork) or excess moisture (e.g. flooding, leaks, condensation, damp filters, or elevated humidity) (Burge, 1987; Morey et al., 1986). Excessive mold and/or bacterial concentrations in indoor air primarily impact the health of allergy-prone (atopic) individuals. Such persons may experience the relatively common symptoms of allergic rhinitis or asthma shortly after initial exposure (Canadian Public Health Association, 1987). Much less frequently, airborne microorganisms cause susceptible individuals to develop severe hypersensitivity illnesses or opportunistic infections (Burge, 1987; Moret et al., 1984). Two opportunistic fungal pathogens (e.g., Aspergillus niger and A. fumigatus) can cause infection in persons with weakened immune systems (Raper and Fennell, 1965; Morey and Feeley. 1990).

ANTIGENS AND ALLERGENS

Microorganisms may produce antigens (proteins or carbohydrates capable of stimulating an immune response) in indoor water reservoirs which can aerosol (≤ 1.0 μm). Antigens of appropriately small size apparently do not reach concentrations in free outdoor air that are sufficient to cause sensitization (Burge, 1990a). Allergic asthma and allergic rhinitis are two diseases which are apparently less dependent on small aerosol size than hypersensitivity pneumonitis and humidifier fever, and are triggered by continuing exposure to ambient levels of appropriate allergens (substances that induce allergies), whether these allergens are indoors or outdoors (Salvaggio and Aukrust, 1981). It is possible that diverse indoor factors, such as excessive humidity, unsuspected noxious particles, and volatile irritants released from household goods or appliances, may exacerbate asthma in the absence of sensitizing agents (Ahmed et al., 1982).

VIRUSES

Some examples of viral bioaerosols which infect humans and are spread by aerosols, rather than by direct contact only, are influenza (influenza A and B), measles (rubella), mumps, and chicken pox (Knudsen, 1980; Nada et al., 1986).

BACTERIA

Bacterial bioaerosols are responsible for such things as tuberculosis (Mycobacterium), Legionnaires' disease (Legionella pneumophila), and hypersensitivity pneumonitis (Thermoactinomyces). Airborne transmission occurs when an infected person is coughing, sneezing, actively shedding fresh organisms into air close to susceptible individuals, or even talking or singing (Burge, 1990b).

FUNGI

Approximately 200 surveys made in various parts of the world of outdoor airborne spores indicated that Cladosporium, Alternaria, Penicillium, and Aspergillus were the genera of fungi which accounted for the highest mean percentages. Approximately 85% of patients found to be allergic to molds will react to one or more of these same genera in circulating air (Binnie, 1989). Alternaria sp., Cladosporium sp., and Penicillium sp., are three fungi which have been associated with causing asthma and rhinitis. Penicillium species with spores of 2 to 3 microns (μm) have apparently been responsible for several hypersensitivity pneumonitis epidemics (Kreiss and Hodgson, 1984).

The “moldy” or “mildew” odors in some indoor environments are associated with low levels of volatile organic compounds (VOCs) in the air produced by fungi (Kaminski et al., 1974; Canadian Department of Health & Welfare, 1987). Health effects have not been directly attributable to these VOCs to date, but the VOCs and/or the organisms which produce them may be contributory factors to complaints of headache, eye and throat irritation, nausea, dizziness, and fatigue in subjects occupying contaminated interiors (Burge, 1990a).

PROTOZOA

Protozoa (i.e. amoebae, ciliates, etc.) can grow in indoor water reservoirs. A few of these protozoa can cause severe infections (Mannis et al., 1986), but most produce either antigenic or toxic metabolic products which aerosol and may contribute to syndromes such as hypersensitivity pneumonitis and humidifier fever (Edwards et al., 1976).

STANDARDS AND GUIDELINES

There are no practical identification methods for a number of fungal spores, algae, actinomycetes, bacteria, as well as certain types of biogenic debris (Nagda et al., 1986). National standards for levels or airborne microbes in buildings are not yet available (Kay et al., 1991).

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